United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Environment, Energy and Natural Resources, Committee on Government Operations, House of Representatives

May 1992

HAZARDOUS MATERIALS

Upgrading of Underground Storage Tanks Can Be Improved to Avoid Costly Cleanups

GAO/NSIAD-92-117

GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-213706

May 13, 1992

The Honorable Mike Synar
Chairman, Subcommittee on Environment,
Energy and Natural Resources
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

This report responds to your request that we review the Department of Defense program for ensuring that the condition of its underground storage tanks will be in compliance with state and federal laws for upgrading them.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time, we will send copies to the Chairmen of other appropriate committees; the Secretaries of Defense, the Air Force, the Army, and the Navy; the Director, Office of Management and Budget; and other interested parties.

Please contact me at (202) 275-4268 if you or your staff have any questions concerning this report. Other major contributors to this report are listed in appendix III.

Sincerely yours,

Nancy R. Kingsbury
Director
Air Force Issues

Executive Summary

Purpose

The Environmental Protection Agency (EPA) estimates that hundreds of thousands of underground storage tanks containing petroleum or hazardous chemicals are leaking and pose a threat to public health and the environment.

The Chairman, Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, asked GAO to review the Department of Defense's (DOD) handling of its underground storage tanks. In response, GAO (1) determined the type and number of tanks owned by DOD and (2) evaluated DOD's efforts to comply with both federal and state requirements, including its efforts to identify and prevent leaks and spills and to correct environmental damage from leaking tanks.

Background

Most of DOD's underground storage tanks are single-walled steel tanks that do not have corrosion protection and have an average life expectancy of 16 to 20 years. Most were installed prior to 1965 and are now beyond their average life expectancy.

Under legislation enacted in 1984, Congress required EPA to develop regulations to protect public health and the environment from leaking underground storage tanks. Leaking tanks can contaminate nearby groundwater, which is the primary source of drinking water for half of the population of the United States. They can also cause fires and explosions. In late 1988, EPA adopted regulations requiring all tank owners, including DOD, to

- ensure that new underground storage tanks have automatic leak detection, corrosion protection, and spill and overflow protection;
- by 1998 upgrade all existing tanks to meet the new-tank standards and, until they do, annually test nonupgraded tanks for leaks;
- clean up damages caused by leaking tanks; and
- close inactive substandard tanks after 12 months after being taken out of service.

State regulations supersede EPA's regulations if they are more stringent.

Results in Brief

DOD reported that in 1989 it owned 30,692 underground storage tanks in the continental U.S., Alaska, and Hawaii that were subject to EPA or state regulations. However, service officials stated that the lack of historical

records on older tanks, together with misinterpreted instructions, incomplete responses, and the incorrect inclusion of unregulated tanks on replies to DOD environmental status reports, raised questions about the accuracy of this inventory. Moreover, there may have been additional thousands of DOD-owned tanks, which because they were excluded or deferred from current regulations, were not included in this figure. In April 1991, DOD service officials tried to collect more current data and the services reported (except that the Air Force did not report its data on unregulated tanks) that they had 24,886 regulated tanks and 17,719 unregulated tanks. While the services did not get responses from some military installations and partial responses from others, they believed that the data was much more accurate than they reported in 1989. DOD is continuing its efforts to accurately identify the number of underground storage tanks it owns.

DOD has made progress in meeting EPA requirements. For example, although DOD did not meet EPA's leak-testing requirements in 1989 and again in 1990, its compliance level increased from 41 percent in 1989 to 78 percent in 1990. However, progress on other aspects of the problems posed by underground tanks has been limited due primarily to a lack of priority for funds.

Principal Findings

Accurate Inventory Data Not Available

Records on the number, type, and location of older tanks are often not available or are inaccurate because they were not regulated before 1984. As a result, several installations have had to complete tank surveys to improve the accuracy of their inventories. DOD installations can, for the most part, identify tanks that are currently active, but have difficulty in locating tanks that were taken out of service or abandoned in the past. Accurate data is critical to understanding the dimensions of the tank problem, particularly which tanks are subject to regulation and in need of remedial action.

Early Upgrading Encouraged But Not Accomplished

The Army, the Navy, and the Air Force have all issued policies that require full compliance with EPA's new tank standards and encourage the use of above-ground replacement tanks. Service officials also acknowledge the

advantages of upgrading single-walled tanks as soon as possible. However, few tanks have actually been upgraded because, the services say, funding to do so has been lacking.

EPA's Leak-Testing Requirements Not Met

DOD has not met EPA's leak-detection requirements. Based upon data gathered for GAO, compliance improved significantly, from about 41 percent of known tanks being tested in 1989 to about 78 percent in 1990. (DOD currently plans to report 1992 compliance statistics in 1993.) However, many contaminated sites may go undiscovered for years because inactive tanks that could leak are not being properly closed or not removed in a timely manner.

Officials in the services and environmental agencies advised GAO that DOD has also made progress in complying with EPA requirements that unnecessary tanks be closed, that tanks that do not meet new-tank standards be upgraded, that leaking tanks be identified, and that environmental damage be corrected.

Cleanup Efforts Limited by Funding Rules and Unavailability

The primary source of monies for upgrading and cleaning up underground storage tanks is operation and maintenance funds. However, the services will not allocate such funds for this purpose unless a compliance deadline has passed or will be passed in the current budget year. Environmental compliance deadlines are rare. And since EPA regulations do not require upgrading to be completed until 1998, upgrades and cleanups do not usually receive funding.

Reprogramming operation and maintenance funds from other projects to clean up storage tanks is also generally not feasible because of the high costs. Other problems, such as the complexity of environmental contracts and the time it takes to award them, also delay cleanup actions.

Congress established the Defense Environmental Restoration Account for cleaning up contaminated sites. However, DOD made a decision to limit the use of those funds to tanks taken out of service before January 1984 or that had leaked before March 1986. For some installations, proving that their tanks met either criteria was difficult and expensive. As a result, the funds were not widely used. The eligibility criteria has recently been broadened, however, and these funds can now be used for all regulated

tanks. However, tank cleanups must compete for funding with cleanup of all of DOD's hazardous waste projects, which are estimated to cost over $24.5 billion for fiscal years 1991 through 2012.

Comprehensive Plans Can Improve Direction and Decisionmaking

DOD does not have a comprehensive program plan to improve its implementation of EPA regulations. For the most part, corrective action plans are developed and implemented at the installation level and, while some installations perform well, others are lagging behind. Because DOD has no plans, it cannot ensure that upgrades and other goals will be made in the most environmentally safe and cost-effective manner and that installations comply with environmental regulations. DOD also does not have an estimate of the cost to comply with DOD regulations.

Unregulated Tanks Also Pose Problems

By leak testing and cleaning up tanks that are excluded or deferred from regulation but that pose a significant threat to public health and the environment, DOD can further reduce the risks posed by leaking tanks. DOD owns thousands of heating oil, emergency generator, and large field-constructed tanks that are currently excluded or deferred from EPA regulation. These tanks comprise more than half of DOD's total tanks, including DOD's largest, and can pose significant risks to public health and the environment.

Recommendations

GAO recommends that the Secretary of Defense develop a comprehensive plan that provides for accurate data on the number, condition, and remedial actions needed on underground tanks and provides guidance on the allocation of funding and resources to ensure compliance with regulations.

GAO also recommends that the services give more attention to assuring that tanks taken out of service are closed promptly and prioritize the upgrading of leaking tanks. Specific recommendations are in chapters 2 and 3.

Agency Comments

As requested, GAO did not obtain written DOD comments on this report. However, GAO discussed a draft of this report with officials from the offices of the Secretary of Defense, the Inspector General, the services, and the Defense Logistics Agency, who generally agreed with the findings. We incorporated their comments as appropriate.

Contents

Abbreviations

DERA	Defense Environmental Restoration Account
DLA	Defense Logistics Agency
DOD	Department of Defense
EPA	Environmental Protection Agency
GAO	General Accounting Office
O&M	operation and maintenance
UST	underground storage tank

ntroduction

The Environmental Protection Agency (EPA) estimates that 4.8 million underground storage tanks (USTs) in the United States contain petroleum products or hazardous chemicals and that 10 to 25 percent of them may be leaking. Leaking USTs can threaten public health and the environment, cause fires and explosions, and contaminate groundwater.

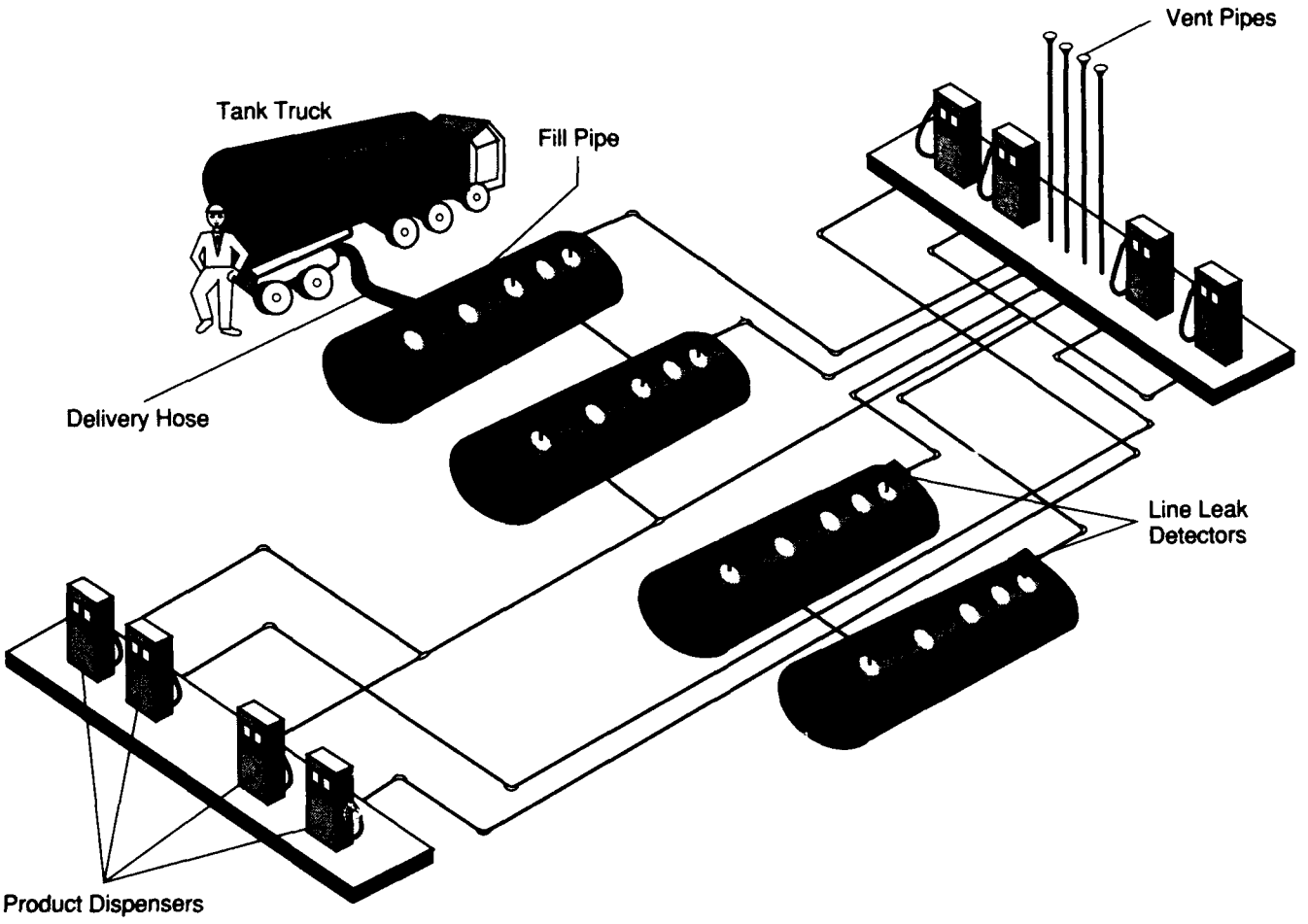
Jot All Tanks Subject o UST Regulation

Congress amended the Solid Waste Disposal Act in 1984. The amendment required EPA to develop regulations to protect public health and the environment from leaking USTs. In late 1988, EPA issued those regulations. They require owners, including government agencies such as the Department of Defense (DOD), to identify and prevent leaks and spills from USTs, and made owners and operators responsible for damages and corrective actions. However, only about 1.7 million USTs are covered by EPA's regulations. Examples of tanks not covered are:

- those with a capacity of 110 gallons or less,
- farm and residential tanks holding 1,100 gallons or less,
- those storing heating oil used on the premises,
- those on or above the floor of underground areas,
- septic tanks and systems for collecting storm water and wastewater,
- flow-through process tanks, and
- emergency spill and overfill tanks.

In addition, tanks providing fuel to emergency generators are among those deferred by EPA regulations from leak-detection requirements and large field-constructed tanks (tanks assembled or constructed at the site as opposed to tanks manufactured in a factory) are deferred from both leak-detection and upgrade requirements. EPA's regulations are usually adopted by the states, but, in some cases, they are superseded by more stringent state regulations. DOD is responsible for complying with EPA or state regulations, whichever is more stringent. Figure 1.1 illustrates the layout of a typical UST facility.

ure 1.1: A Typical Tank Facility



Source: EPA.

DOD reported in 1989 that it had identified over 30,000 regulated USTs on military installations in the United States. These USTs contain petroleum products such as gasoline or aviation fuel and toxic chemicals that are subject to EPA and state regulations. USTs are sometimes used to store used oil. DOD does not have complete data on the total number of USTs that are

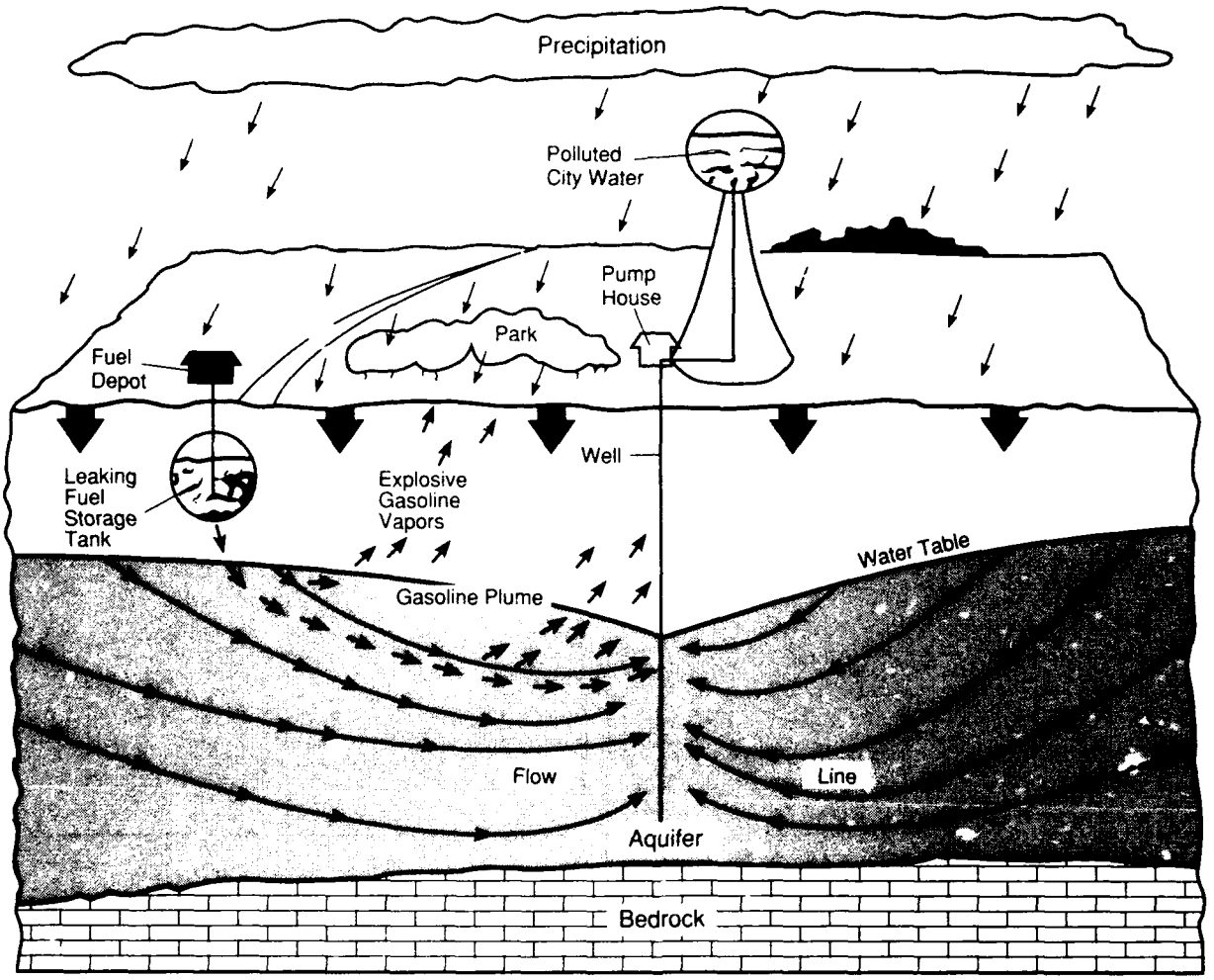
unregulated, excluded, or deferred from EPA regulations. This report provides information on DOD's program for complying with EPA and state regulations for USTs and identifies actions DOD can take to improve its program and reduce the threat of environmental contamination.

Risks Posed by Leaking USTs

Most of DOD's USTs are single-walled steel tanks that do not have corrosion protection and have an average life expectancy of 16 to 20 years. However, most were installed prior to 1965 and now are beyond their average life expectancy. The greatest enemy of steel tanks is corrosion. Moreover, the higher the moisture content of the soil the tank is in, the greater the potential for corrosion and leaks. According to the Defense Environmental Status Report, about 25 percent of the USTs DOD leak tested in 1989 were leaking.

According to EPA studies, the risk to public health and the environment from leaking USTs depends largely upon location, the hazardous nature of the contents, and how quickly leaks can be detected and corrective actions taken. As shown in figure 1.2, USTs located above or near drinking water aquifers that serve large populations pose a greater threat than USTs far removed from drinking water sources.

igure 1.2: How a Leaking UST Can Pollute a Typical Drinking Water Aquifer



Source: EPA

Regulations Governing USTs

EPA's UST regulations detail the actions owners and operators must take to prevent, identify, and correct the damage caused by leaks and spills. In general, they are required to take four steps—(1) close inactive substandard USTs, (2) upgrade those that do not meet new tank standards,

(3) identify those that have leaked or now leak, and (4) clean up contaminated sites.

Closing, Removing, or Upgrading Existing Tanks

Under EPA regulations, all existing USTs and piping must be upgraded or taken out of service by December 1998. Figure 1.3 shows the deadlines for upgrading underground storage tanks. Upgrades may be accomplished by either replacing or adding required equipment to the existing USTs. Replacement tanks may be either above ground or new USTs that meet the regulatory standards.

Figure 1.3: EPA Upgrade Requirements

TYPE OF TANK & PIPING	LEAK DETECTION	CORROSION PROTECTION	SPILL/OVERFILL PREVENTION
New Tanks and Piping[a]	At installation	At installation	At installation
Existing Tanks[b] Installed:	By No Later Than:		
Before 1965 or unknown	December 1989	December 1998	December 1998
1965 - 1969	December 1990		
1970 - 1974	December 1991		
1975 - 1979	December 1992		
1980 - December 1988	December 1993		
Existing Piping[b]	December 1990	December 1998	Does not apply
Pressurized	Same as existing tanks	December 1998	Does not apply
Suction			

[a]New tanks and piping are those installed after December 1988.

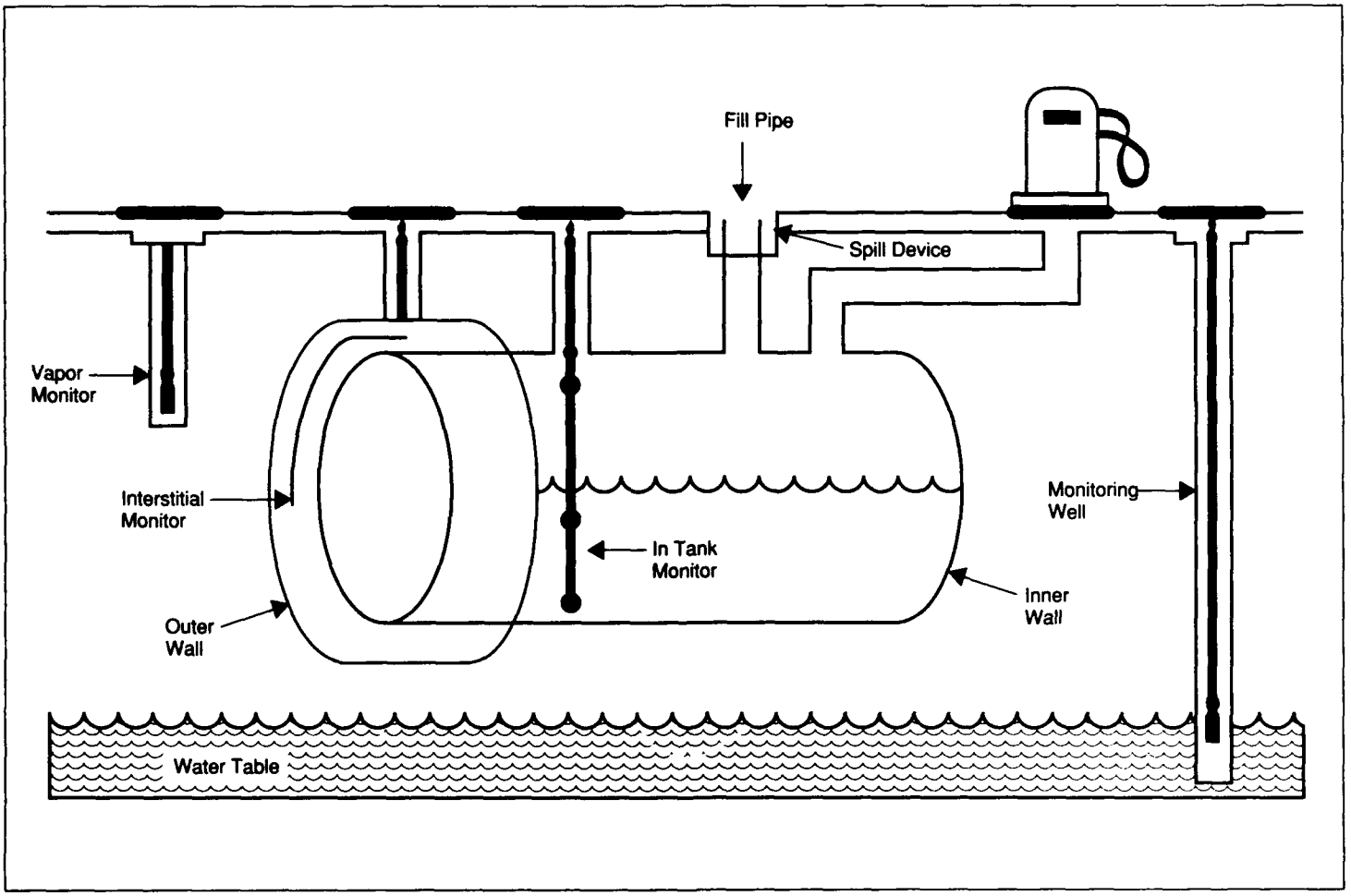
[b]Existing tanks and piping are those installed before December 1988.

Source: EPA.

The objective of the requirement for secondary containment is to contain leaks and spills within the UST and prevent external contamination. Secondary containment may consist of double-walled tanks and piping, a liner that cannot be penetrated by the tanks contents, or a concrete vault.

Figure 1.4 illustrates a double-walled fiberglass UST with spill and overfill protection and several leak-detection devices.

Figure 1.4: A Double-Walled UST with Leak Detection and Spill and Overfill Protection



Source: EPA.

Leak Detection

EPA requires annual leak-detection tests and monthly inventory controls for USTs that do not meet the standards for new or upgraded USTs. For USTs with spill, overfill, and corrosion protection, EPA requires monthly inventory controls and leak testing only once every 5 years until 1998.

Owners/operators must also determine if leaks from USTs taken out of service after December 1988 have damaged the surrounding environment.

This determination must be made and the tank removed, permanently closed, or converted to a nonregulated purpose after 12 months after being taken out of service. The applicable regulatory authority must be notified 30 days before these actions are taken.

When a leak or spill is discovered, the owner/operator is required to:

- take immediate steps to stop and contain the leak or spill,
- report leaks or spills larger than 25 gallons to the applicable regulatory authority within 24 hours,
- eliminate immediate hazards to health or safety by removing explosive vapors and fire hazards, and
- investigate to determine if the leak has damaged or might damage the environment.

Cleaning Up Contamination

Whenever environmental damage is discovered, EPA requires several actions. The owner/operator must investigate to determine the nature and extent of the environmental damage, assess any current or future threat to public health, and prepare a corrective action plan that must be approved by the applicable regulatory authority—i.e., the EPA or a state.

DOD has delegated responsibility for the actual management of its USTs to the Army, the Navy, the Air Force, and the Defense Logistics Agency (DLA). Each, in turn, has instructed its installation commanders to comply with EPA and state UST regulations. With regard to base closings, $220 million was appropriated for fiscal year 1992 for cleanup of hazardous waste on those bases, including USTs. State regulatory authorities generally hold installation officials responsible for compliance. Responsible officials may be subject to civil and criminal penalties if they fail to comply with regulatory notices and environmental orders.

In addition, the owner/operator is financially responsible for cleaning up the damage and compensating people for any bodily injury or property damage. That can be costly, especially when it involves groundwater. For example, a Navy study estimates that when the contamination reaches groundwater, the average cleanup cost ranges from $250,000 to $2.5 million. If detection and cleanup occur before the contamination reaches the groundwater, the Navy estimates the average cost at about $40,000. An Army study reported similar cost estimates.

Objectives, Scope, and Methodology

The Chairman of the Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, asked us to (1) determine the number and type of USTs DOD owns, (2) evaluate DOD's efforts to comply with state and federal UST requirements, and (3) evaluate DOD's efforts to identify and prevent leaks and spills, and to correct environmental damage from leaking USTs.

Our work was performed at EPA, DOD, Army, Navy, Air Force, and DLA headquarters in the Washington, D.C., area. We also performed work at 15 military installations within the continental United States and Hawaii (see app. I) that either the subcommittee staff asked us to review or that we selected because the regulations of the states they were located in were more stringent than EPA's. We also performed work at the major commands of the installations, except for the Air Force Logistics Command, (see app. II) at state regulatory agencies in Oklahoma, Texas, Hawaii, California, and Florida, and at private concerns such as the American Petroleum Institute and the Phillips Petroleum Company.

We obtained data from DOD, EPA, and state regulatory officials on the status of DOD's compliance with EPA and state regulations of USTs, including the number of USTs owned, abandoned, regulated, taken out of service, installed, upgraded, removed, or permanently closed in place. (In those instances in the report where we note that the service or installation was not in compliance with EPA regulations, they also were not in compliance with state regulations.) We then went to the particular locations and reviewed the accuracy and adequacy of the USTs records by checking the supporting documentation maintained by the DOD and the installations visited.

We reviewed management actions and instructions for implementing EPA and state UST regulations. We also examined DOD's methods of funding UST compliance actions including upgrades, leak detection, tank closures, site assessments, and cleanup costs.

As requested, we did not obtain written DOD comments on this report. However, we discussed a draft of this report with DOD program officials, who generally agreed with the findings, and incorporated their comments as appropriate.

GAO has also issued reports on owners and operators insuring underground petroleum tanks; the adequacy of federal regulation of above ground oil storage tanks; and given testimony on the ability of underground

petroleum storage tank owners ability to comply with federal financial responsibility requirements. (See list at the end of the report.)

We conducted our work during the period April 1990 and December 1991 in accordance with generally accepted government auditing standards. Major contributors to this report are listed in appendix III.

DOD's Compliance With UST Regulatory Requirements Is Improving

DOD's efforts to meet EPA's regulations were slow in getting underway but are showing improvement. DOD, DLA, and the services have made some progress in complying with EPA or state requirements. For example, based upon data gathered for GAO, by December 22, 1989, DOD installations had only leak tested 41 percent of the USTs known to require testing, but by December 22, 1990, it leak tested 78 percent of the USTs. About 25 percent of the tanks were found to be leaking. This data is not reported on a regular basis and was obtained through a special data call, but DOD currently plans to report on 1992 compliance statistics in 1993. However, DOD still needs an accurate inventory of its USTs as well as a comprehensive management plan that properly allocates resources and assures both that the USTs are upgraded in an environmentally safe, cost-effective manner and that the installations are complying with applicable regulations. Other problems include a lack of technical expertise and timely funding for site investigations and cleanups.

Inaccurate or Incomplete UST Inventory Data Add to Delayed Compliance

Accurate UST inventories are critical to DOD, service, and installation officials for several reasons—to enable them to understand the scope of the problems they are facing in this area; develop management plans, criteria, policies, and guidance; allocate resources; and ensure compliance and exercise oversight. However, DOD installations often lack accurate or complete inventories of their USTs and do not know which of their USTs continue to be used, needed, and subject to regulations.

In the past, installations were not required to keep records on the numbers, types, and locations of their tanks. Moreover over the years, tank caretakers have changed and tanks have been taken out of service and, in some cases, abandoned.

According to service officials, when we began our review, the most current data available on USTs was the 1989 annual Defense Environmental Status Report. It reported that DOD owned 30,692 USTs that were subject to EPA or state regulations. However, we were told that due to the lack of historical records on older tanks, misinterpreted instructions on environmental reports, incomplete responses, and the incorrect inclusion of unregulated tanks, that report contained inaccurate data.

In April 1991, service officials tried to collect more current statistics from their commands and installations. A majority of the commands and installations responded, but some did not respond fully and some did not respond at all. As a result, DOD does not have an accurate inventory of

DOD-owned tanks. Still, because of this latest effort, service officials believe that their new data is much more accurate than the data they reported in 1989. The latest DOD inventory of USTs is shown in table 2.1.

Table 2.1: Number of DOD-Owned USTs

Service	Regulated	Unregulated
Army	8,178	12,285
Navy	8,803	5,243
Air Force	7,757	[a]
DLA	148	191
	24,886	17,719[a]

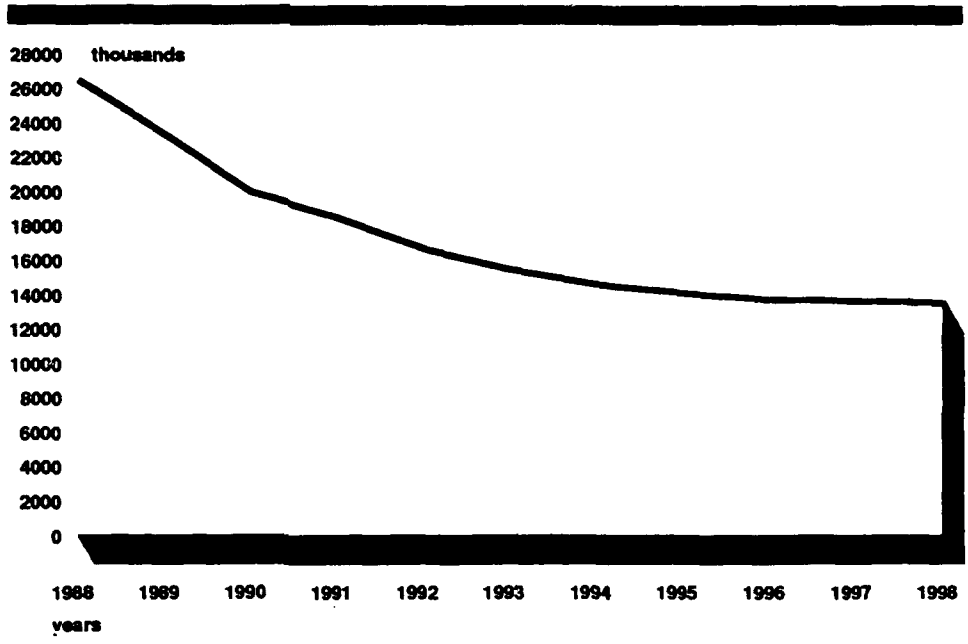
[a]The Air Force did not report this data.

The services are attempting to develop automated systems to track the UST inventory. For example, the Army system, referred to as "Tankman," will be used by installation personnel to monitor UST inventories, funding, management reports, and compliance with requirements.

Closing and Removing USTs

Another area the services are improving is closing or removing unnecessary USTs. Figure 2.1 is a projection the services made of the reduction they expect in the estimated number of active, regulated USTs that will be taken out of service between 1988 and 1998. Generally, much of the reduction will come from two categories—USTs that have already been abandoned and those that are no longer needed. According to service officials, DOD abandoned a large number of USTs and no longer needs a significant percentage of its active USTs. For example, the Navy reports that it has about 2,400 abandoned USTs. Abandoned tanks are a concern because many may have been leaking when taken out of service or, if the contents were not removed, started to leak in subsequent years. Officials at Fort Sill and Vance Air Force Base, both in Oklahoma, believe that 50 percent or more of their active USTs are no longer needed. Throughout DOD, USTs have become unneeded as a result of changes such as storing waste oil in drums rather than USTs.

Figure 2.1: DOD Active EPA Regulated USTs



Source: GAO compilation of service data.

Early Upgrading of USTs Encouraged

EPA's regulations do not require all USTs to be upgraded until 1998. However, EPA encourages earlier action as a way to avoid future leaks and cleanup costs and unnecessary leak-detection costs. The Army, Navy, and Air Force all have issued policies that require full compliance with EPA's new tank standards and encourage the use of above ground replacement tanks. Because it has only a small number of regulated tanks—about 148—DLA has not issued any formal policy.

Service officials also acknowledge the advantages of upgrading their single-walled USTs early. For example, upgraded tanks do not require annual leak testing, and they significantly reduce both the number of leaks and spills and the time it takes to discover them when they do occur. However, service officials have not accelerated upgrading primarily because of a lack of funding. As a result, few USTs had been upgraded.

Between December 1988 and December 1990, the Army, Navy, and DLA retrofitted 154 existing USTs to meet the new tank standards by adding leak-detection devices, corrosion protection, and spill and overfill prevention devices. The Air Force does not maintain retrofit statistics. Although most replacement tanks installed by the services were above ground, some USTs were upgraded by being replaced with new USTs.

These new USTs meet new tank standards, and many are double-walled tanks or single-walled tanks placed inside vaults, which provide secondary containment should the tank leak. See table 2.2 for the number and type of new USTs installed by the services.

Table 2.2: New UST Installations Between December 1988 and December 1990.

Service	Regulated new tanks[a]	Total new tanks	Type				New tanks meeting EPA 1998 standards
			Fiberglass	Steel	Vaulted	Other	
Army	696	878	275	558	45	0	496
Navy	221	266	104	92	65	5	195
Air Force	111	[b]	[b]	[b]	[b]	[b]	[b]
DLA	41	41	41	0	0	0	41
Total	**1,069**	**1,185**	**420**	**650**	**110**	**5**	**732**

[a]Regulated tanks includes tanks regulated by either a state or the EPA. Some state regulated USTs, such as heating oil tanks, are not required to meet EPA 1998 new tank standards.

[b]Not reported.

1989 and 1990 Leak-Test Requirements Not Met

According to EPA's requirements, regulated USTs must be leak tested. Regulated, active USTs installed prior to 1965 must be leak tested in 1989, and those installed prior to 1970 must be leak tested in 1990. As shown in table 2.3, DOD did not meet EPA's leak-testing requirements for 1989. Although the compliance level for 1990 improved significantly, DOD and the services still were not in compliance with EPA's requirements.

Table 2.3: USTs Known to Require Leak Testing and USTs Actually Tested by the Services in 1989 and 1990

Service	December 22, 1989		December 22, 1990	
	Tanks requiring testing	Tanks tested	Tanks requiring testing	Tanks tested
Army	2,865	1,544	2,790	2,680
Navy	3,801	1,594	3,670	1,906
Air Force[a]	4,716	1,479	3,611	3,258
DLA	82	62	87	61
Total[b]	**11,464**	**4,679**	**10,158**	**7,905**

[a]The Air Force figures may be misleading because they consider a tank to be in compliance with the 1990 leak-detection requirements if it had been leak tested in either 1989 or 1990. EPA regulations require tanks that do not meet performance standards for new or upgraded USTs to be leak tested annually. Substandard tanks leak tested in 1989 should also have been leak tested in 1990.

[b]Data are included only for those installations that responded to the services' data request. DLA reported that 100 percent of the installations fully responded and the remaining services believe that the data represents at least 84 percent or more of their active regulated tanks.

According to DOD and service officials, the main reasons for not complying with the 1989 and 1990 leak-test requirements were a lack of program planning for timely funding and a lack of technical expertise to either conduct leak testing in-house or contract out for it. Furthermore, personnel at some installations had difficulty in determining which tanks required testing because the inventory records did not accurately identify all existing tanks or the dates they were installed.

EPA's Closure Requirements Not Met

EPA's closure requirements generally apply to all USTs taken out of service after December 1988. They call for owner operators to do two things after a UST has been out of service for 12 months—(1) either remove the UST from the ground or permanently close it in place and (2) conduct a site investigation. The purpose of the site investigation is to determine (1) whether contamination has occurred and to what extent, (2) the necessary immediate containment actions, and (3) the method of cleanup or remedy.

To avoid future liability, DOD and the services prefer to remove inactive tanks rather than permanently close them. Moreover, by removing the tank, soil and/or groundwater samples can generally be extracted with less effort. However, of the 15 installations we visited, only 9 had been able to permanently close in place or remove all their USTs after they were out of service for 12 months. The other six were not in compliance in either 1989 or 1990.

Investigation and Cleanup May Take Years

Military installations also may take several years to investigate their contaminated sites and clean them up. According to a DOD official, the process is lengthy primarily because of the complex, time-consuming steps that must be followed to obtain funding and to award contracts for site investigation and cleanup. For example, simply awarding a contract for the site investigation can take several months. At some of the installations we visited, officials cited another problem—that they lack the technical expertise necessary to write the contract statements of work for site investigations and cleanups.

Furthermore, once the site investigation is completed, requests for cleanup funds may be made; but, funding generally does not occur until the following budget year. When funds are obtained, the steps required for the actual cleanup work may take several additional months or years. It is this lengthy process that has hampered DOD's compliance with EPA's cleanup requirements.

Table 2.4 shows the number of leaks reported in 1989 by each service.

ible 2.4: Leaking USTs

Service	Number of leaking USTs
Army	368
Navy	306
Air Force	316
DLA	6
Total	**996**

Source: Defense Environmental Status Report for fiscal year 1989.

However, table 2.5 shows that, at the installations we visited, of the 137 leaking USTs identified by various means in 1989 and 1990, cleanup was begun at only 74, or 55 percent. As of July 1991, the cleanup process had been completed for only one leaking tank. Furthermore, for various reasons such as a lack of accurate data and timely testing, the 137 may not be all the USTs leaking on these installations.

Table 2.5: Status of Leaking USTs at 15 Installations Visited

Installation	Number of leaking USTs discovered during 1989	1990	Total	As of July 1991 Cleanup in process	Cleanup completed
Tinker Air Force Base	4	0	**4**	4	0
Travis Air Force Base	2	3	**5**	0	0
MacDill Air Force Base	[a]	24	**24**	24	0
Vance Air Force Base	0	1	**1**	0	1
Fort Ord	6	7	**13**	0	0
Fort Sill	21	5	**26**	21	0
Pensacola Naval Air Station	0	0	**0**	•	•
Point Mugu Naval Air Station	20	12	**32**	23	0
Corpus Christi Naval Air Station	0	3	**3**	2	0
San Pedro Defense Fuel Supply Point	0	0	**0**	•	•
Hickam Air Force Base	[a]	0	**0**	•	•
Fort Shafter	[a]	[a]	[a]	•	•
Schofield Barracks	[a]	[a]	[a]	•	•
Kaneohe Bay Marine Corps Air Station	0	5	**5**	0	0
Pearl Harbor	8	16	**24**	0	0
Total	**61**	**76**	**137**	**74**	**1**

[a]These installations did not leak test their tanks and no leaks were identified by any other means.

Source: Information obtained at installations visited and from service officials.

Sources of Funds for UST Sites

Funding to Upgrade USTs

The primary source of funds available for upgrading USTs is operation and maintenance (O&M) funds. However, the services generally will not allocate O&M funds to fulfill environmental regulations unless a compliance deadline has passed or will be reached in the current budget year. Regulatory authorities can set compliance deadlines by issuing a notice of violation or compliance order; however, we were told that such actions on DOD installations are rare. Moreover since under EPA regulations upgrading is not required to be completed until 1998, there is no immediate compliance deadline to drive funding for upgrades.

An exception is the Navy, which has set aside about $30 million a year of O&M funds for environmental compliance. These funds are referred to as

pollution abatement funds and are allocated to installations for leak detection, tank removal, and a small number of upgrades by the Navy's Engineering Field Divisions.

According to service officials, installation commanders and major command officials can also reprogram O&M funds from other projects to upgrade facilities. However, service officials pointed out that since normally only projects for high-priority facilities are funded, they would be reprogramming funds from high-priority projects and that could hamper base operations. Major command officials stated that another potential source of funds are O&M funds that cannot be used for the intended project that year. In those cases, the problem is the intense competition for those funds and the difficulty in spending them before the fiscal year ends.

Installations that have upgraded their USTs usually have not obtained funds using the standard O&M budget process. Instead, according to service officials, funds from other accounts such as construction funds (when the tanks are part of a larger military construction project) or industrial funds have been used to pay for replacement tanks. For example, Navy officials at Point Mugu Naval Air Station, California, and Pensacola Naval Air Station, Florida, used industrial funds to upgrade USTs.

nding for Cleanup of UST es

Congress established the Defense Environmental Restoration Account (DERA) funding system for cleaning up all of DOD's contaminated sites. Appropriated amounts for installation restoration programs have risen from $150 million in fiscal year 1984 to $1.4 billion in fiscal year 1992, almost all of which are DERA funds. (The fiscal year 1992 amount also included $220 million for the base closure account.) However, when DOD officials implemented the UST program in 1988, they made a decision to limit the use of DERA funds for UST purposes to sites contaminated by USTs that had been taken out of service prior to January 1984 or that had leaked prior to March 1986. The DOD, however, on November 15, 1991, changed that decision and is now allowing DERA funds to be used for tanks that leak prior to December 22, 1993, the date by which all regulated USTs that do not meet the upgraded standards must be leak tested at least annually.

According to a Navy official, when there were limits on the use of DERA funds, some were used to remove or close some USTs taken out of service after 1988 and to clean up any contamination they left. However, Army and Air Force officials stated that only a small percentage of the sites contaminated by USTs were eligible for DERA funding at that time. They say

that proving the tanks leaked prior to March 1986 was both difficult and expensive. Navy officials stated that they relied on statements from installation officials to determine DERA eligibility.

Service officials noted that DERA funds are used for other environmental cleanup efforts and that UST-contaminated sites must compete for funding. They stated that a DOD priority system is used to identify the worst sites and UST-contaminated sites often have low funding priority compared to other DERA projects. They stated that much more work has been done for other types of contamination, such as imminent threats from hazardous or toxic substances or sites listed or proposed for the national priorities list.

O&M funds are the primary funding source of cleanup projects not funded by DERA. As discussed earlier, obtaining O&M funds for environmental cleanup is both difficult and time consuming. The DOD priority system is not used to rank O&M funded cleanup projects to ensure that the worst contaminated sites or those posing the greatest danger to public health and the environment are cleaned first. Instead, to be considered for O&M funding, the services generally will not allocate funds to environmental cleanup projects unless there is a compliance deadline set by a notice of violation, a compliance order issued by a regulatory authority, or the agency has entered into a consent agreement.

Furthermore, as discussed earlier, installation commanders or major command officials can reprogram O&M funds from other projects to fund UST cleanups. However, according to these officials, the cost of cleaning up a major leak is usually so large that they cannot reprogram O&M funds without seriously hampering other base operations.

Once cleanup funds are obtained, a statement of work must be written and a contract awarded for the actual cleanup. According to DOD and service officials, these steps can take several additional months or years. The contractor must determine the extent and nature of the contamination, how it can best be cleaned up or contained, and what it will cost before any actual work is done. The lengthy process of investigating, funding, and contracting has hampered DOD's compliance with EPA's regulatory requirements for cleanup.

Better Policy Guidance Can Aid Decision-Making

The services have developed criteria and provided some guidance to assist installation and major command officials in making compliance decisions. For example, the Army has developed a training course with Georgia Institute of Technology assistance and has also issued a technical guide covering good UST management. However, installation officials do not have guidance for determining when a UST is needed, can be economically and safely retrofitted, and should be upgraded. In addition, they need uniform criteria to select the most cost-effective, environmentally safe replacement tank. According to DOD and service officials, uniform criteria would assure that compliance decisions are based on a complete understanding of all relevant factors, that all alternatives are considered, and that the experiences of officials from various installations are shared.

According to guidelines used by all the services, the decision to upgrade depends on a UST's condition, its contents, and the environmental sensitivity of the tank's location. These guidelines require replacement of USTs in poor condition. However, decisionmakers do not have guidance to assist them in weighing the risk of continuing to use existing single-walled USTs against the cost of double-walled USTs or above-ground replacement tanks.

The services have developed computer programs that rank both USTs and contaminated sites according to the potential risk they pose for public health and the environment. Service officials state that once these programs are distributed, they will help installation and major command officials establish a priority ranking for upgrading USTs and cleaning up contaminated sites.

Improved Oversight Needed

To assure that installations comply with applicable regulations, DOD, DLA, and the services need to institute adequate oversight procedures. Without such oversight, DOD managers do not have the information they need to understand the nature and scope of the problems they and lower level managers face in protecting the environment and public health. Oversight also allows installations in the forefront of change to share their experience and knowledge with other installations, possibly leading to uniform DOD or service criteria and guidance.

According to DOD and service officials, the compliance statistics provided in the past were incomplete and inaccurate, but there are ongoing efforts to improve the system. Currently all the services oversee management of USTs by requiring some compliance statistics to be reported and by

conducting limited reviews of USTs during annual environmental audits. In addition, the environmental audits are limited in scope and conducted primarily by installation officials whose findings generally do not get reported to the service level. Violations noted during the audits require the major commands to take action.

The Defense Environmental Status Report, which was published for 1989 and 1990, contained compliance status statistics provided by the services for active, regulated USTs but none for inactive, nonregulated USTs, which represent a significant percentage of DOD's USTs. In 1990, the report was replaced by the Defense Environmental Management Information System. The new system, with the exception of the number of violation notices, does not include UST compliance statistics. The Army, Navy, and Air Force continue to gather Defense Environmental Status Report data at the service level and the services each have plans to build a computerized data information system that includes this information.

In addition, DOD and service officials need to know how many of their inactive USTs were never leak tested. DOD and service officials will not know the scope of UST environmental problems until all existing and past leaks are identified and the number of needed tanks and the cost of corrective measures is known. Responsible officials must understand the need to give priority to corrective actions aimed at avoiding greater environmental damage, cleanup costs, and public health threats. The services also need these statistics to monitor the progress of installation efforts.

According to service officials, annual environmental audits consist primarily of answering hundreds of pages of environment-related questions. However, some services had only two or three of these pages apply to USTs. The audit team is usually made up of installation officials, but may include personnel from the major command or the Navy's Engineering Field Division. The reports and findings are sent to the major commands but are generally not forwarded to the service headquarters or DOD levels. DOD and service officials need this information to provide adequate oversight.

Conclusions

The majority of DOD's USTs are old, bare, single-walled steel tanks. Many are now leaking or have leaked in the past. A large number were abandoned years ago and others are no longer needed. DOD is making progress on the UST program but needs to do more in several areas—identifying leaking USTs, taking steps to prevent future leaks and spills, identifying unneeded tanks, removing or permanently closing inactive tanks, and cleaning up the contaminated sites. The services do not have a comprehensive UST management plan, sufficient and accurate data on USTs, the costs that could be incurred to meet EPA regulations, and the adequate technical expertise to do the job. Finally, DOD has not provided sufficient guidance to the services and is unable to exercise oversight to ensure compliance with UST regulations.

Recommendations

We recommend that the Secretary of Defense

- Develop a comprehensive UST management plan that provides for compiling sufficient and accurate data and provides guidance on allocation of funding and other resources, including technical expertise to support the services' activities and Office of the Secretary of Defenses's oversight of compliance with UST regulations.
- Direct the services to comply with the requirement to permanently close or remove inactive USTs that have been out of service more than 12 months and determine if they have created any contamination.

More Attention to Problems Posing Imminent Danger Could Reduce Environmental and Public Health Risks

By assessing and prioritizing its tanks and then upgrading them, and by extending coverage to unregulated tanks, DOD can both cut down on leaks and spills that might otherwise occur and reduce cleanup costs. Instead DOD has generally postponed upgrading its tanks, preferring to wait until 1998. According to service officials, only the newer, larger existing USTs that are in good condition will be kept in service. The services estimate that the majority of existing tanks will eventually be taken out of service either because they are no longer required or because they will be replaced with new tanks.

Savings Achievable Through Early Attention

A 1988 Navy study found that the most environmentally safe and economical way to comply with EPA UST regulations was to assess and prioritize upgrade decisions. This study analyzed more than 6,000 USTs, which were found similar in type, age, use, and regional soil conditions from a universe of 70,000 tanks at 22,000 locations. The study concluded that the cost over a 10-year period of maintaining the USTs at EPA's minimum-requirements level would be about $13 million; on the other hand, if the tanks were assessed and given a priority for upgrading, the 10-year cost would be only about $6.5 million, a net savings of $6.5 million or 50 percent. Table 3.1 details the costs for each of the alternatives the study considered for 100 sites with three tanks per site.

Table 3.1: Alternatives

Action to take	10-year costs
Minimum EPA	$12,996,739
Replace by age	11,670,559
Replace all in year 1	10,426,001
Leak detection	9,851,367
Assess/prioritize/upgrade	6,480,010

Source: 1988 Navy study.

According to a 1988 EPA study, the primary cost associated with accelerating upgrades and replacing tanks is the interest cost on the investment between the date the action is taken and the final compliance date of 1998, less the cost savings realized by avoiding leak-detection costs and by mitigating contamination cleanup costs. Table 3.2, based on the American Petroleum Institute's 1987 cost estimate survey of service stations, provides a representative cost for installing a 10,000-gallon tank, assuming three tanks are installed per site. The cost of these tanks depends on several factors including the type of tank, its capacity, and location.

Table 3.2: Representative Costs of New Replacement Tanks

Steel		Fiberglass	
Single-walled	**Double-walled**	**Single-walled**	**Double-walled**
$21,400	$36,700	$23,300	$39,000

Similarly, table 3.3 shows the representative cost of the equipment needed to upgrade a 10,000-gallon UST and associated fuel lines to new tank standards, assuming an average of three tanks per site. In some cases, the cost of upgrading will be less because some of DOD's existing tanks already have some of these features.

Table 3.3: Representative Costs of Upgrading Existing USTs

Leak-detection method	First year cost	Recurring annual cost
Vapor sensor	$1,400	$1,200
Automatic gauging	3,800	a
One groundwater monitoring well	2,500	a
Tightness tests	600	600
Corrosion protection—cathodic	2,500	a
Fill pipe spill containment	800	0
Overfill protection	1,100	0

[a]Specific operational cost data was not available.

High Priority Should Be Given to USTs Posing the Greatest Risk

DOD could enhance its UST program by giving high priority to those USTs that pose the most immediate and serious threats to health and the environment, especially those near underground drinking water supplies. There is a need for priorities because some USTs are more apt to leak, some contents are more hazardous, and some tanks are located in more environmentally sensitive areas.

The American Petroleum Institute identified corrosion as the primary cause of leaks in steel USTs. The National Institute for Petroleum and Energy Research determined that corrosion depends upon the amount of stray electrical current in the area and the quantity of moisture in the soil to carry the electrical current. The presence of moisture in the soil is dependent upon annual rainfall and soil permeability in a geographical area. Clay, for example, retains moisture longer than sand.

According to DOD and EPA officials, tanks in highly corrosive environments, particularly those near underground water supplies, should receive priority

over those in arid regions far removed from groundwater. By giving them high priority, DOD may be able to avoid the most serious and costly risks. A system for setting priorities is particularly important when funding is not available for all tasks to be accomplished in a relatively short time.

Early detection and cleanup is always important but can be critical if a UST is located over drinking water supplies. This is especially true if there is a direct conduit to the source of the drinking water, such as a nearby water well. For example, Tinker Air Force Base, Oklahoma; Fort Ord, California; and Pensacola Naval Air Station, Florida; all have drinking water wells that could become contaminated if diesel fuel leaks from the nearby USTs serving emergency generators.

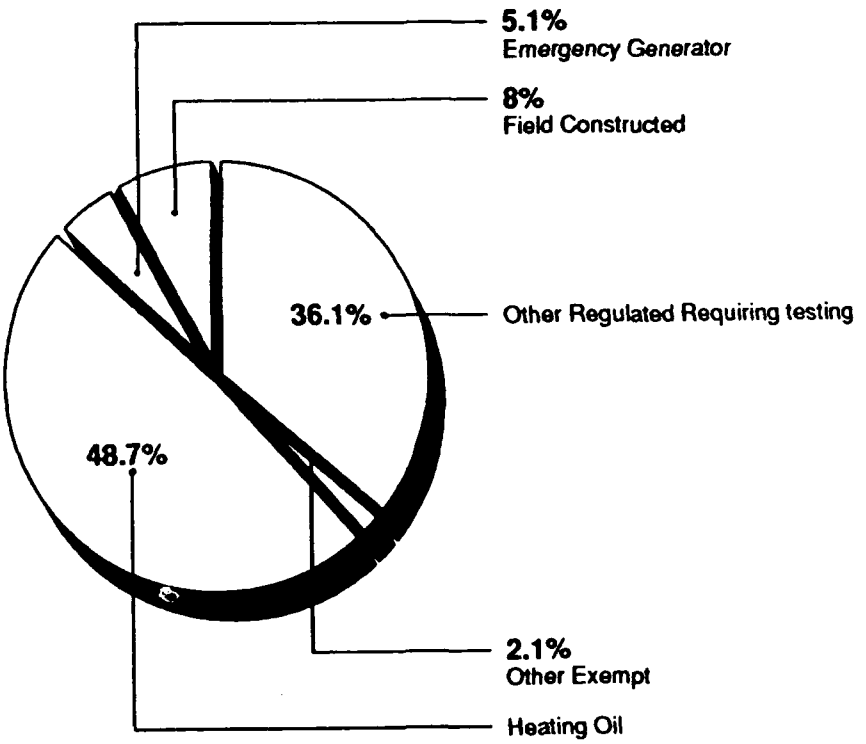
If the services accelerate funding to accomplish all upgrades, leak testing, and tank replacements simultaneously, priority becomes less important. However, unless this occurs throughout the services, a system of priority setting needs to be a key element in reducing DOD's risk and preventing future contamination.

DOD Can Reduce Its Risk by Extending Coverage to Unregulated USTs

By extending coverage to USTs that are not covered by law or EPA regulations but have an equal potential for causing contamination, DOD can improve its protection of public health and the environment, and avoid risks of future remedial costs. There are three types of USTs in that category—those containing heating oil, those containing fuel for emergency generators, and DOD's large field-constructed tanks. Such unregulated tanks comprise nearly 64 percent of DOD's total active tanks, including its largest.[1] Figure 3.1 shows the number of DOD USTs by type/purpose.

[1]This figure is based on data provided by the Army, the Navy, and the DLA. The Air Force did not provide this information.

Figure 3.1: UST Type and Purpose Determine Leak-Testing Exception or Deferral Status



DOD installation officials found that a significant number of their regulated USTs were no longer needed. A similar analysis of excluded and deferred USTs may also find that a significant number of them can be taken out of service.

Furthermore, leak-detection tests of regulated USTs have identified a number of leaks, as have leak tests of excluded and deferred tanks. The elimination of leaks from unregulated USTs would further reduce DOD's risk. Moreover, some states require unregulated USTs to be tested and upgraded, in spite of their exclusion or deferral by EPA. Also, a few DOD installations and major commands have tested these tanks because they believe the tests are cost effective and reduce the risk to the environment and public health.

Heating Oil USTs

Approximately 49 percent of DOD's estimated active USTs are heating oil tanks. Most store fuel for boilers that heat large buildings. Often, they are not the primary but a back-up source for boilers operating on natural gas. Although specifically excluded from EPA's definition of USTs and exempt from many state upgrade and leak-detection requirements, these tanks pose essentially the same threat as regulated USTs that contain petroleum products.

Business firms, which use large USTs to store boiler fuel to heat commercial buildings or to provide industrial power, sought and obtained this exclusion from EPA. EPA, in turn, granted the exception because its primary objective is regulating USTs used in the commercial motor fuel sales industry, primarily the ones storing gasoline.

USTs containing heating oil, like most of the regulated USTs (i.e., single-walled steel tanks installed before 1965), are prone to leaking and may be located in environmentally sensitive areas. Heating oil USTs pose essentially the same risks and liabilities as tanks that are currently regulated. The Army and some Air Force commands require that heating oil tanks be tested for leaks.

Emergency Generator USTs

Tanks that store fuel for emergency generators are deferred from leak detection but must be upgraded by 1998. They are only a small percent of DOD's total USTs but pose a similar risk to public health and the environment as the regulated USTs. With capacities of from 200 to 2,000 gallons, they are smaller than most of the regulated USTs; however, their contents are similar or the same as regulated USTs. According to an EPA official, unlike many regulated USTs, inventory records are not kept on the amount of fuel put into and dispensed from these tanks. Thus, leaks cannot be identified by inventory discrepancies.

One of the most serious threats to public health and the environment is that some of these USTs provide fuel to emergency power generators at drinking water wells. Because these tanks sit atop a drinking water aquifer, fuel from leaks can enter drinking water supplies in a short time. Environmental damage can be extensive and the cleanup costs and public health risks extremely high.

Representatives of private firms, such as telephone or electric utility companies that use USTs to support emergency generators in remote areas, convinced EPA that the cost of getting workers and equipment to these

remote areas to leak test a single, small UST containing diesel was not cost effective. However, unlike such firms, DOD's emergency generators are usually not located in remote areas. Most are located near buildings, such as hospitals, communication equipment, or water well pumps on large military bases. To prevent leaks from going undetected, some major commands require emergency generator tanks to be leak tested at the same time that other tanks on the base are tested.

Field-Constructed USTs

Field-constructed tanks are DOD's largest USTs. They contain anywhere from 50,000 to more than 12 million gallons of fuel, and some are located over major drinking water aquifers. For example, the Navy has 20 field-constructed USTs, each with more than a 12-million-gallon capacity, sitting atop Hawaii's most productive drinking water aquifer.

Field-constructed tanks are constructed on the site from material such as concrete and/or steel. In contrast, the typical UST is manufactured in a plant from steel or fiberglass and then transported to the site for installation. At DOD's request, field-constructed USTs were deferred from EPA's upgrade and leak-detection requirements because their size and irregular shape prevented measuring devices from accurately detecting tenth-of-a-gallon-per-hour leaks, as required by EPA regulations.

Many field-constructed USTs are equipped with devices capable of measuring the volume of fuel on hand and large leaks might be detected by comparing periodic volume measurements with inventory records. However, changes in temperature and/or atmospheric pressure make volume measurements inaccurate to detect leaks of a tenth-of-a-gallon-per-hour.

However, this problem might be overcome with new leak-testing methods. According to these experts, changes in the temperature or atmospheric pressure do not affect the accuracy of leak detectors that use either a vapor sensing or a laser measuring device.

Conclusions

DOD can reduce the risk of environmental damage and its liability from leaking USTs by accelerating the schedule for upgrading them. For the most part, DOD's efforts are geared toward compliance with EPA and state regulations, and DOD generally performs leak tests on those tanks approaching EPA deadlines. EPA regulations encourage accelerated upgrades and leak testing. DOD can further reduce contamination, cleanup,

and liability risks by upgrading and leak testing tanks that pose a similar threat to public health and the environment but that are excluded or deferred from EPA regulations.

Recommendations

We recommend that the Secretary of Defense direct the services to give more attention to the problem of leaking USTs by

- accelerating leak testing and upgrading to the maximum extent practical,
- assigning high priority to those USTs posing the greatest risk, particularly, those near underground drinking water supplies, and
- acting on high-risk USTs that are currently deferred or excluded from EPA regulations.

Installations Visited

Corpus Christi Naval Air Station, Texas

Fort Ord, California

Fort Sill, Oklahoma

Fort Shafter, Hawaii

Hickam Air Force Base, Hawaii

Kaneohe Bay Marine Corps Air Station, Hawaii

MacDill Air Force Base, Florida

Pearl Harbor, Hawaii

Pensacola Naval Air Station, Florida

Point Mugu Naval Air Station, California

San Pedro Defense Fuel Supply Point, California

Schofield Barracks, Hawaii

Tinker Air Force Base, Oklahoma

Travis Air Force Base, California

Vance Air Force Base, Oklahoma

Major Commands Visited

Army Corps of Engineers, Washington, D.C.

Army Material Command, Virginia

Army Training and Indoctrination Command, Virginia

Army Western Command, Hawaii

Navy Air Systems Command, Virginia

Navy Facilities Command, Virginia

Air Force Engineering and Service Center, Florida

Air Force Military Airlift Command, Illinois

Air Force Tactical Air Command, Virginia

Air Force Training Command, Texas

Pacific Command, Hawaii

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Related GAO Products

Underground Petroleum Tank Owners' Ability to Comply With Federal Financial Responsibility Requirements (GAO/T-RCED-90-48, Mar. 21, 1990)

Underground Petroleum Storage Tank Owners' Ability to Comply With Federal Financial Responsibility Requirements (GAO/T-RCED-90-29, Feb. 20, 1990)

Ability of Underground Petroleum Storage Tank Owners to Comply With Federal Financial Responsibility Requirements (GAO/T-RCED-90-9, Oct. 31, 1989)

Inland Oil Spills: Stronger Regulation and Enforcement Needed to Avoid Future Incidents (GAO/RCED-89-65, Feb. 22, 1989)

Superfund: Insuring Underground Petroleum Tanks (GAO/RCED-88-39, Jan. 15, 1988)